

Space Weather Technical Forecast

Issued on Saturday, 01 January 2022 at 00:50 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Slight chance of G1/Minor storm on 01 January.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was low, with two C-class flares originating from AR2918 (Bxo/Beta) in the northwest quadrant, with the first a C9.8 flare observed at 31/0654UTC and a second, C8.1 flare observed at 31/1946UTC. There appeared to be a filament eruption associated with the first C9.8 flare, although analysis suggests that this may have been reabsorbed. There are five regions on the visible disc. AR2916 (Eai/Beta) has seen some fading of intermediate spots, but is still large with a complex magnetic structure. AR2918 (Axx/Alpha) produced the aforementioned C-class flares. This region will be rotating off the disc in the next 24 hours. AR2922 in the southeast and the unclassified region to the south of 2916 have both developed relatively rapidly into Cro/Beta regions. A prominence lifted off from the southwest of the Sun at around 31/0700UTC, which subsequently produced a CME, which has been analysed and is thought not to be Earth-directed. No Earth-directed CMEs have been observed on available imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as observed at L1, started the period at around 470km/s as the Earth connected with the high speed stream from coronal hole 39. The winds have continued to decline back to near background levels of 400km/s by the end of the period. Density has been steady and around average for much of the period, with a minor fluctuation to above average, with a peak of 15 ppcc at 31/2100UTC. Total magnetic field strength has been weak throughout the period. The all important north-south component Bz, has varied weakly. Phi angle was mainly positive (away from the Sun). Geomagnetic activity has been Quiet throughout. (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at background levels. High energy (greater than 2MeV) electron flux has been at background to moderate levels. Electron fluence was well below the Active (1e8 integrated pfu) threshold. Observed fluence at 01/0000UTC was 6.48e6 integrated pfu.

Four-Day Space Weather Forecast Summary

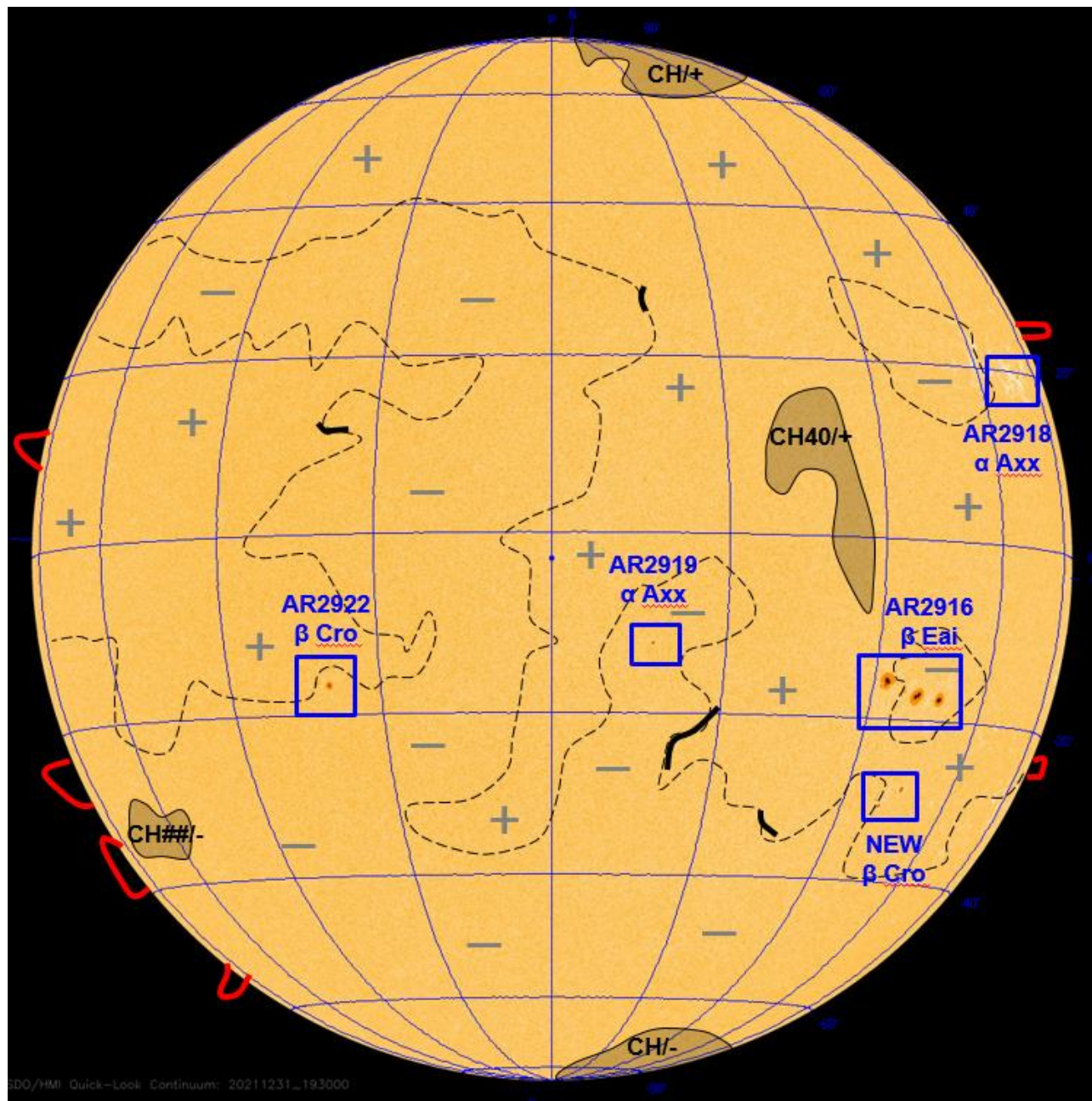
Solar Activity: Low or very low solar activity is expected, with a slight chance of M-class flares from either 2916 or 2918, although the latter will be rotating off disc in the next 24 hours.

Solar Wind / Geomagnetic Activity: No CMEs are currently expected in this forecast period. A high speed stream of 500km/s from coronal hole 40 is expected to connect with the Earth on day 1 (01 Jan). Speeds are likely to remain at this level through days 2 and 3 (02-03 Jan), but then start declining on day 4 (04 Jan). Geomagnetic activity is expected to be mainly Quiet to Unsettled, but with a risk of Active or G1/Minor Storm intervals on day 1 (01 Jan) due to the onset of the high speed stream from CH40.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

expected to remain at background levels, albeit with a very slight chance of S1 due to the potential contained within the two most significant sunspot regions. High energy electron flux values are expected to remain below the high (1e3pfu) threshold on days 1 and 2 (01-02 Jan), with a slight chance of increasing above the threshold on days 3 and 4 (03-04 Jan) on diurnal peaks. Electron fluence is forecast to remain below the Active (1e8 integrated pfu) threshold, but with an increasing trend on 02 and 03 January.

Figure 1. Solar Analysis Valid 31/1930UTC.



Key: Filament — , Prominence — , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-γ-δ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

No Earth-directed CMEs are currently in the forecast.

The high speed stream from coronal hole 39 has now declined, with solar winds reduced to background levels. Coronal hole 40 is expected to connect with the Earth on day 1 (01 Jan), with speeds of around 500km/s forecast, based on persistence and limited STEREO A data, which may persist through day 2 (02 Jan). A decline in speed is then likely later on day 3 and through day 4 (03-04 Jan).

Geomagnetic activity is forecast to be mainly Quiet to Unsettled through much of the period, with isolated Active or G1/Minor Storm intervals on day 1 (01 Jan) due to the onset of the high speed stream from CH40.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Radio Blackouts - X-Ray Flares:

Solar activity is expected to be low or very low over the next four days with only large and stable or small and benign sunspots on the visible disc.

AR2916 (Eai/beta) is the largest region, but has not produced any significant activity through the last 48 hours. AR2918 (Bxo/beta) is following a declining trend, but recently produced two C-class flares, which suggests the possibility of significant flare potential as it continues to rotate towards the northwest horizon. The other remaining regions are all small unipolar spots.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	10	10	10
Very Active	R3 to R5 X Class	No	3	1	1	1

Figure 2: AR2916 (Eai/Beta) in the southwest quadrant – stable and little signs of further development.

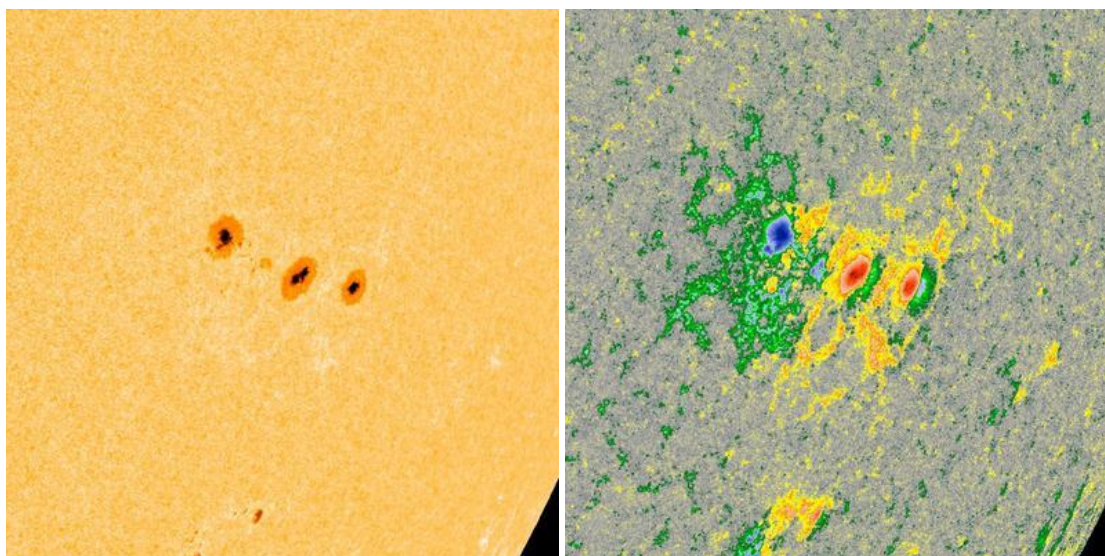
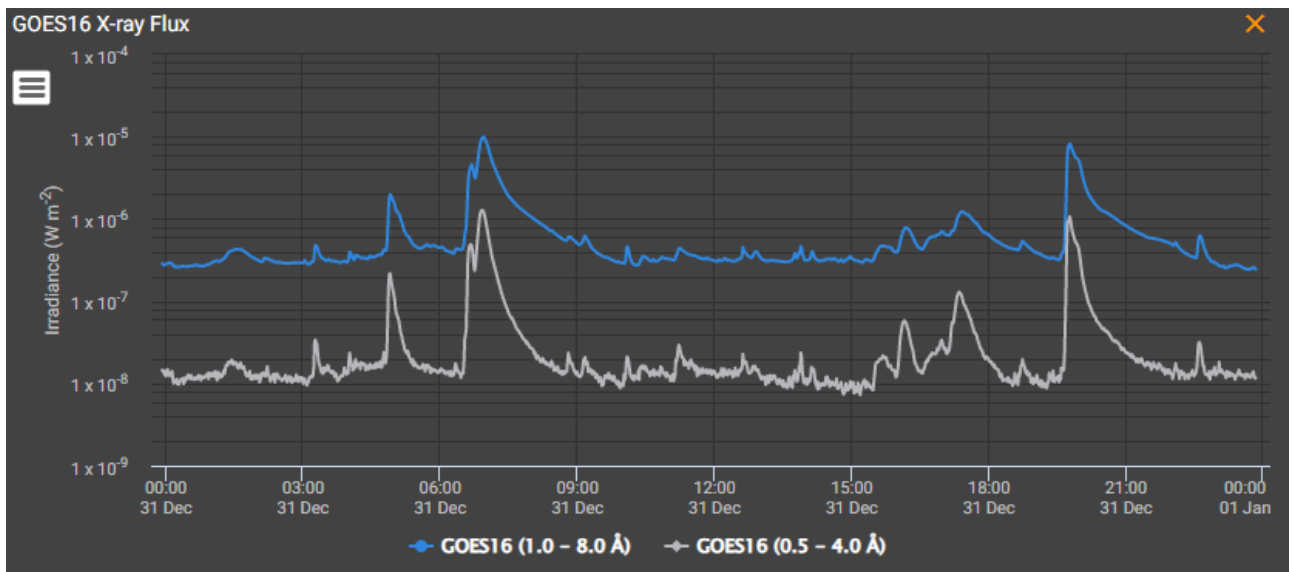


Figure 3: GOES-16 X-ray flux with the two C-class flares from AR2918 at 0656UTC and 1946UTC.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at background levels and will most likely persist as such. Despite the apparent stability, 2916 and 2918 continue to be monitored for potential radiation storms.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm ⁻² sr ⁻¹ s ⁻¹)						

High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux (greater than 2MeV) is expected to be at background levels and may be limited by any geomagnetic activity due to the onset of the high speed stream from coronal hole 40 on day 1 (01 Jan). Electron flux values are then likely to increase as the wind strengthens, with high ($1\text{e}3\text{pfu}$) levels possible through days 3 and 4 (03-04 Jan).

Electron fluence values are forecast to remain below the Active ($1\text{e}8$ integrated pfu) threshold, but with a rising trend on days 3 and 4.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1\text{e}8$	No	1	5	10	10
Very Active	$\geq 2 \text{ MeV}$ $\geq 1\text{e}9$	No	1	1	1	1

Figure 4: REFM electron fluence.

